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(54) Method for controlling the sodium carbonate concentration of green liquor in the dissolving tank.

(57) A method for regulating the sodium carbonate concentration of a green liquor (17) in the dissolving tank (14) of the Kraft recovery process by measuring the conductivity of the green liquor from the dissolving tank, measuring the conductivity and flow rate of a weak wash solution (16) being added to the green liquor in the dissolving tank, using these measurements to determine the sodium carbonate concentration of the green liquor in the dissolving tank, and adjusting the volume of the weak wash solution (16) being added to the dissolving tank in response to changes in the concentration of sodium carbonate in the green liquor so as to maintain the concentration of sodium carbonate in the green liquor at a predetermined, preferably constant, level.
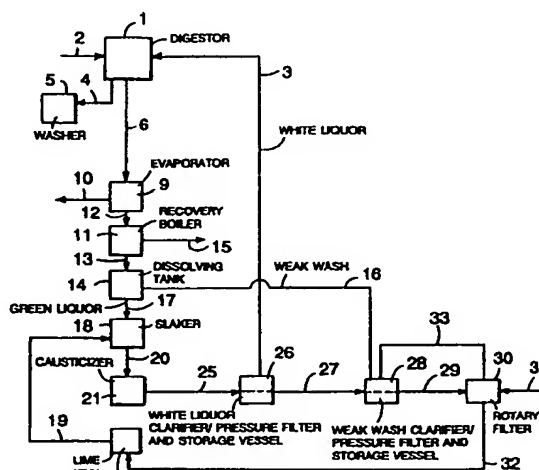
FIG.I

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centration of the green liquor, and then adjusting the volume of the weak wash solution added to the dissolving tank in response to changes in the concentration of sodium carbonate in the green liquor so as to maintain the concentration of sodium carbonate in the green liquor at a pre-determined, preferably constant, level.

The above-described method regulates sodium carbonate concentration based on measurements that are more accurate than such indirect measures as the density of the green liquor or total titratable alkali in the green liquor. Since the strategy is based on continuous on-line measurements, it is possible to continually regulate the sodium carbonate concentration in the dissolving tank.

Other features and advantages of the invention will be apparent from the following description of the preferred embodiments thereof, and from the claims.

The drawings are first briefly described.

Figure 1 is a schematic view of a portion of a pulp mill operation including the various components and piping involved in the Kraft recovery process.

Figure 2 is a schematic view of the various components and piping involved in a process for regulating the sodium carbonate concentration of the green liquor in the dissolving tank.

The method of the invention takes advantage of the fact that although there are three primary compounds present in the dissolving tank, the concentration of sodium carbonate can be estimated using a non-specific sensor, e.g., a conductivity probe.

The method of the invention can be more clearly understood by considering the composition of the green liquor in the dissolving tank. In the dissolving tank green liquor is formed by combinig smelt and weak wash. The three primary compounds in the dissolving tank are: sodium carbonate, sodium hydroxide and sodium sulphate. Of course, a conductivity measurement of the green liquor will detect all three compounds, not just sodium carbonate. However, the fact that the compounds in the green liquor are contributed by different sources permits a non-selective conductivity measurement to be corrected and used to estimate the sodium carbonate concentration in the dissolving tank. While both the smelt and the weak wash are the source of sodium sulphate, the only source of sodium hydroxide is the weak wash, and the smelt is the only source of sodium carbonate. Accordingly, it is possible to calculate the sodium carbonate concentration simply by measuring the conductivity of gr en liquor exiting the dissolving tank and correcting the measurement for sodium hydroxide and sodium sulphate. The correction for sodium hydroxide is made using on-line measure-

ments of both the conductivity and flow rate of the weak wash solution being added to the dissolving tank. The correction for sodium sulphate is simplified by the fact that concentration of sulphur in the dissolving tank changes very gradually (and over a rather narrow range). Thus, off-line sulphidity data, which is routinely obtained through scheduled analysis, can be used to correct dissolving tank conductivity data for sodium sulphate content.

The conductivity of any solution depends on its temperature. Accordingly, each of the conductivity measurements must be corrected to a reference temperature using appropriate temperature compensation curves. In this manner changes in conductivity caused by temperature variation can be distinguished from conductivity changes caused by concentration changes. Preferably, the reference temperature is relatively close to the operating temperature. For example, 85°C is an appropriate reference temperature for the green liquor, and 25°C is an appropriate reference temperature for the weak wash solution. In practice the conductivity signal is automatically temperature compensated to the appropriate reference temperature prior to the computation of sodium carbonate concentration. The various measurements are conveyed to a programmed computer which calculates an estimate of the sodium carbonate concentration in the green liquor according to a prescribed algorithm and then provides a signal to a controller which adjusts the flow of weak wash into the dissolving tank.

The temperature-compensated conductivity data, the off-line sulphidity data, and the flow of weak wash to the dissolving tank can be used to calculate the green liquor carbonate concentration according to the following algorithms:

(1) $C_{C85} = C_{G85} - (G_{W25} \times F_w \times a_w) - (S_G \times a_s)$

(2) $K_c = C_{C85} \times a_c$

where:

K_c green liquor sodium carbonate (Na_2CO_3) concentration expressed in Na_2O g/L

C_{G85} green liquor conductivity compensated to a special non-linear green liquor temperature compensation curve and referenced to an elevated reference temperature of 85°C

C_{C85} green liquor carbonate conductivity referenced to an elevated reference temperature of 85°C and compensated for sodium hydroxide and sulphidity

C_{W25} weak wash conductivity refer nced to a non-linear sodium hydroxide temperature compensation curve and referenced to a temperature of 25°C

concentrated in lime mud solids and is passed via lin 29 to a rotary filter 30 where the lime mud solids are washed with water admitted via line 31. The washed and dewatered lime mud solids are recycled to the lime kiln 23 via line 32. The lime kiln 23 combusts the lime mud solids to reform calcium oxide which is recycled to the slaker 18 via line 19. The filtrate from the rotary filter 30 is recycled via line 33 to the weak wash clarifier 28. The clarified liquid from the upper portion of the weak wash clarifier is the weak wash which is sent via line 16 to the dissolving tank 14.

With reference to the above-described arrangement, the temperature and conductivity of the green liquor is measured in line 17, and the temperature, conductivity and flow rate of the weak wash is measured in line 16. Off-line sulphidity data is obtained from routine samples of the green liquor in the dissolving tank 14 (or in line 17). These measurements provide the information required to estimate the sodium carbonate concentration of the green liquor in the dissolving tank 14 and adjust the weak wash flow in line 16 accordingly.

The method used to control the sodium carbonate concentration of the green liquor in the dissolving tank can be more completely understood by reference to FIG. 2, which is a schematic representation of the devices used to estimate and control the sodium carbonate concentration in the dissolving tank.

A weak wash conductivity transmitter receives a temperature signal 36 from a temperature probe 37, and an absolute weak wash conductivity signal 38 from a conductivity probe 39. Both probes are located in line 16, which carries weak wash to the dissolving tank 14. A green liquor conductivity transmitter 46 receives a temperature signal 42 from a temperature probe 43 and an absolute green liquor conductivity signal 44 from a conductivity probe 45. Both probes are located in line 17, which draws-off green liquor from the dissolving tank 14. The weak wash conductivity transmitter 40 compensates the absolute weak wash conductivity signal 38 for the effect of variations from a reference temperature of 25°C and sends a compensated weak wash conductivity signal 48 to a high signal selector 49. In a similar fashion green liquor conductivity transmitter 46 compensates the absolute green liquor conductivity signal 44 with respect to a reference temperature of 85°C and sends a comp nsat d gre n liquor conductivity signal 47 to the high signal selector 49. The high signal selector 49 sends compensated green liquor and weak wash conductivity signals 50 to a controller 51 which also receives a flow signal 52 from a flow meter 53 in weak wash line 16. The controller 51 also receives a sulphidity signal 41 which is

entered manually and is based on an off-line measurement. The controller 51 us s these signals to estimate the sodium carbonate concentration of the green liquor in the dissolving tank 14. The controller then sends a control signal 54 to valve 55 in line 16, which line delivers weak wash to the dissolving tank 14. When the sodium carbonate concentration in the dissolving tank 14 is above the desired level, the control signal 54 opens valve 55, admitting more weak wash to the dissolving tank 14. Conversely, when the sodium carbonate concentration in the dissolving tank 14 is below the desired level, the control signal 54 closes valve 55, admitting less weak wash to the dissolving tank 14.

The high signal selector 49 is required only in those instances where the dissolving tank is serviced by two pumps which alternate their service between weak wash and green liquor. For example, for six days pump A pumps green liquor from the dissolving tank to the slaker while pump B sends weak wash to the dissolving tank. During this period, the weak wash flow cleans pipes, sensors, and pumps, and flushes away the sodium carbonate scale built-up during the alternate cycle. In the alternate cycle, pump B draws green liquor from the dissolving tank to the slaker, while pump A brings weak wash to the dissolving tank. When such an arrangement is employed, both conductivity probes will be exposed to either green liquor or weak wash. While this has the advantage of providing for routine cleaning of the sensors, it requires that the device computing the sodium carbonate concentration know which solution a given sensor is being exposed to at any given time. Because the conductivity of the green liquor is always higher than the conductivity of the weak wash, the signals can be distinguished by means of a high signal selector.

Installation of Conductivity Probes

A number of factors should be taken into consideration when installing conductivity probes in the green liquor and weak wash lines. Important objectives include: maintaining a reasonable and relatively constant flow rate past the probe, insuring that the probe remains fully submerged, and preventing large buildup of solids which can interfere with conductivity measurements.

Generally for both weak wash and green liquor a small stream (e.g., 1 inch) is drawn-off the appropriate line on th discharge side of the transf r pump serving that line. The stream is feed into one end of a measuring chamb r near the bottom of the chamber. The stream exits the measuring chamber and returns to the main line through a primary discharge line at the opposite end of the chamber, near the top. The conductivity and tem-
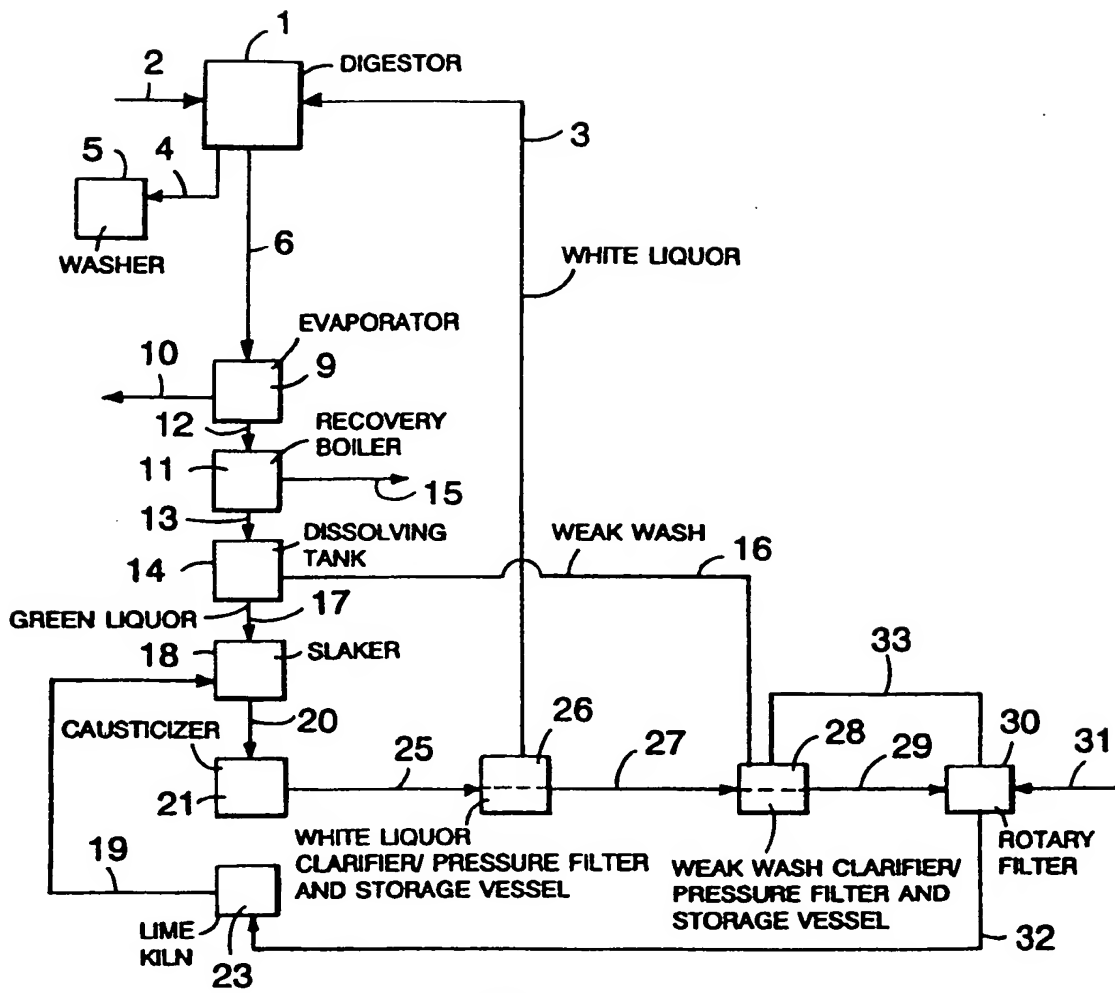
FIG.I

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-4 536 253 (BERTELSEN) * the whole document *	1-4	D21C11/00
D,A	WO-A-8 404 552 (WEYERHAEUSER CO.) * claims *	1,2,4	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D21C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	02 NOVEMBER 1992	BERNARDO NORIEGA F.

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